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RESEARCH ARTICLE

GROWTH AND HAEMATOLOGICAL VARIABLES OF BROILER CHICKEN FED VARYING LEVELS OF DIATOMACEOUS EARTH AS GROWTH PROMOTER

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ABSTRACT

In an experiment carried out to determine the effects of inclusion of different levels of diatomaceous earth (fossil shell flour) on growth and haematological variables of broiler birds was investigated. The experiment comprised 150 day-old Arbor Acre strain of broiler chicks were randomly alloted to five dietary treatments; control (T1) and four differents levels of inclusion of fossil flour 2% (T2), 3% (T3), 4% (T4) and 5% (T5). The control birds were fed normal diet. Each diet was replicated 3 times with 10 birds in each replicate in a completely randomised design. There were no significant ($p>0.05$) differences in the average feed intake, average weight gain and feed conversion ratio of all the birds on the different dietary treatments with values ranging from 1.04 to 1.26 kg/bird, 0.44 to 0.61 kg/bird and 2.04 to 2.33 kg/bird respectively. The result of the haematological parameters of the birds fed the experimental diets revealed that the various inclusion levels of fossil shell o significantly ($P< 0.05$) affected the levels of white blood cells, total protein, glucose, globulin and red blood cells of the birds while albumin, packed cell volume and haemoglobin count were not significantly affected ($P>0.05$). The glucose value increases as the level of fossil shell inclusion increases from 2% (123.00) to 5% (152.75); with birds on diet E (152.75) having the highest significantly value. Haematological indices suggest that the health status of the birds were not adversely affected by the various inclusion levels of fossil shell in their diets. Hence fossil shell could still replace maize in broiler diets up to 5% level; however efforts towards reducing the dustiness of fossil shell could promotes more of its benefits. This study could be extended to layers to know its effect on egg production.

INTRODUCTION

Broilers are chickens reared for their meat to slaughter weight in eight weeks (Smith, 2001). Deep litter system was traditionally found suitable for broiler production (Oluyemi and Robert, 1988). Litter materials use under deep litter system are not naturally sterile, the pathogenic bacteria found in them was an indication of their potential to contain injurious organisms (Asaniyan *et al.*, 2007). Therefore, meeting the nutrient and welfare requirement of broiler chickens under deep litter systems calls for attention. In feed formulation, nutrient requirement of broilers is met by judicious use of feed ingredients to supply adequate amounts and proportions of nutrients required. Broiler welfare is commonly addressed through addition of feed additives, generally referred to as “growth promoters” into the formulated diets. Growth promoters, coupled with properly maintained broiler house condition protect broiler chicken against pathogenic organisms through enhanced immunity status. The commonly used growth promoter in broiler diets is the antibiotics.

Antibiotics became an important element of intense animal husbandry because of their observed growth-enhancing effect, when added in sub-therapeutic doses to animal feed (WHO, 2002). All antibiotics control growth and proliferation of micro organisms; however, all antibiotics do not accomplish this control by the same mechanism (Ferket, 2004). Consequently, antibiotics differ with regard to their ability to influence certain disease state or improve growth and feed efficiency. Pathogenic bacteria resistant to a number of antimicrobial agents emerged worldwide in the 1980s (Aarestrup, 2003). As these were detected, several reports were published recommending a ban on antimicrobial use in food animals as a precautionary measure.

In the United States, recommendations to reduce or eliminate the use of antimicrobials in feed were made in two reports by the Institute of Medicine (1980, 1989), a Council for Agricultural Science and Technology report (1981), and a Committee on Drug Use in Food Animals report (1998). The reports did not present data proving that resistant micro organisms selected during the use of antibiotic growth promoters in food animals cause antibiotic-resistant infections in humans. In fact the

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relationship is still under vigorous debate (Alpharma, 2004; Dawe, 2004; Philips et al., 2004; Vaughn and Copeland, 2004). Poultry Science Association and Western Poultry Conference (WPDC) included sessions on the issue and reports from these and other proceedings discuss the significance of existing scientific evidence that antibiotic resistance in feed animals is associated with resistant infections in humans (Cervantes, 2004). The World Health Organization (WHO) published a report on the medical impact of the use of antimicrobials in food animals suggesting a link between the two on an epidemiological basis (1997). This report (World Health Organization, 2000) recommends, on precautionary grounds, that national governments adopt a proactive approach to reduce the need for antimicrobial use in animals and establish surveillance of antimicrobial growth promoters. WHO suggests that use of antimicrobial growth promoters that are in classes used in humans be terminated or rapidly phased out, by legislation if necessary, unless and until risk assessments are carried out (World Health Organization, 2000). The organization also suggests that animal health management should be routinely practiced so as to avoid the prophylactic use of antimicrobials, and antimicrobial availability should be limited to therapeutic use by prescription. Thus, Cervantes (2004) reported the plans of EU Commission to withdraw approval for the antibiotic growth promoter in EU member Nation in 2006. The ban became fully effective by January 2006. This created a significant need for alternatives to antibiotic growth promoters. Several different feed additives such as amino acids, enzymes, prebiotics, probiotics, organic acids and proprietary blends

Table 1: Dietary composition of broiler birds fed different levels of fossil shell flour (starter phase)

Ingredients	A 0%FS	B 2%FS	C 3%FS	D 4%FS	E 5%FS
Maize	53.15	51.15	50.15	49.15	48.15
Wheat offal	6.00	6.00	6.00	6.00	6.00
Groundnut cake	8.43	8.43	8.43	8.43	8.43
Soybean meal	25.30	25.30	25.30	25.30	25.30
Fish meal	2.50	2.50	2.50	2.50	2.50
Bone meal	2.53	2.53	2.53	2.53	2.53
Lysine	0.84	0.84	0.84	0.84	0.84
Methionine	0.43	0.43	0.43	0.43	0.43
Salt	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude Protein	22.24	22.06	21.97	21.88	21.80
Crude Fat	4.27	4.21	4.17	4.13	4.09
Crude Fibre	4.04	3.98	3.95	3.93	3.90
Calcium	0.17	0.17	0.17	0.17	0.17
Phosphorus	0.47	0.47	0.47	0.46	0.46
Energy ME. Kcal/kg	2797.06	2728.42	2694.10	2659.78	2625.46

FS = Fossil shell

Table 2. Dietary composition of broiler birds fed different levels of fossil shell flour (finisher phase)

Ingredients	A 0%FS	B 2%FS	C 3%FS	D 4%FS	E 5%FS
Maize	59.00	57.00	56.00	55.00	54.00
Groundnut cake	14.00	14.00	14.00	14.00	14.00
Soybean meal	19.00	19.00	19.00	19.00	19.00
Wheat offal	7.00	7.00	7.00	7.00	7.00
Bone meal	1.25	1.25	1.25	1.25	1.25
Oil	2.00	2.00	2.00	2.00	2.00
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
Crude Protein	21.01	20.83	20.74	20.66	20.57
Crude Fat	6.65	6.57	6.53	6.49	6.45
Crude Fibre	4.06	4.01	3.98	3.96	3.93
Calcium	0.21	0.21	0.21	0.21	0.21
Phosphorus	0.45	0.45	0.44	0.44	0.44
Energy ME. Kcal/kg	3090.48	3022.98	2987.52	2953.20	2918.88

FS = Fossil shell

are emerging as potential alternatives. Prebiotics and probiotics supplements enhanced performance of the broiler birds (Ezeokeke, 2008).

Another recently known alternative to antibiotics is the Diatomaceous Earth (DE) (fossil shell, FS). The Notes written by Sands (1998) on Safe Solutions, Inc. reported that DE or Grass of the sea is so pure that the Food and Drug Administration has given it a "food-grade" designation. The governments of the United States and Canada recognize that fossil shell flour is safe to use in animal foods in an amount not to exceed 2% by weight of the total feed ration. When added at this percentage, fossil shell flour prevents "clumping" of feed particles by keeping them separate, so there is improved flowability, mixability and handling of the animal feed. This in turn, creates two big advantages to the animals who consume fossil shell flour in their recommended feed ration. First acting as an anti-caking agent to prevent "clumping" of feed particles, the surface area of feed exposed to the digestive processes; both bacterial and enzymatic is increased and therefore more feed is actually digested and utilized. Secondly, fossil shell flour contains a small amount of fourteen trace minerals. Thousands of animal owners and livestock breeders have discovered that adding fossil shell flour to their animals' rations has produced a number of incredible benefits. Hence, this study tends to bring out the effect of various replacement levels of maize (energy source) with fossil shell growth promoter (DE) in broiler diets; on the growth and haematological indices of broiler chicken.

MATERIALS AND METHODS

Experimental chicks: A total of one hundred and fifty day old broiler chicks were obtained from a commercial hatchery for the experiment.

Litter materials: The birds were raised on deep litter in fifteen equidimensional pens. Wood shavings and saw-dusts from the same wood type *(Brachystegia eurycoma)*, rice-husks, sharp sand (from erosion deposits) and grass (*Eleusine indica)* (air dried at room temperature, cut to 25-30 mm lengths) were used

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Management of chicks and Experimental layout

The study was carried out at the Teaching and Research Farm of the University of Ibadan, Ibadan, Nigeria for a period of eight weeks. The birds were randomly divided into five equal treatment groups of 30 birds each, such that the mean group weight per replicate was identical. Birds in each group were further sub-divided into three replicates with 10 birds per replicate. The basal composition of the five dietary treatments (Tables 1and 2) contained 0%, 2%, 3%, 4% and 5% levels of fossil shell (FS) growth promoter (Diatomaceous earth of fresh water type) for both starter and finisher phases of the study, the fossil shell were added at expense of corn. The design of the experiment was of the completely randomized design (CRD) and the birds were fed their respective experimental diets *ad-libitum*. Group live body weight and feed intake of each replicate were recorded on weekly basis, from which weight gains and feed conversion ratio for the eight-week period were computed.

Blood/ Serum Collection and Analysis

At the eighth week of the experiment, precisely three hours to the termination of the feeding trial, the birds were starved. Thereafter, two birds from each replicate were weighed, stunned and slaughtered by severing the jugular veins with a sharp surgical knife. The blood was then allowed to flow freely into labeled bijour bottles; one set into which a speck of an anticoagulant, Ethylene diamine tetra-acetic acid (EDTA) powder was introduced to prevent clotting while the other set were without EDTA. The blood in the EDTA-containing bijour bottles were used for the determination of haematological parameters while those in bottles without EDTA were processed for serum protein as described by Lamb (1981).

Data Analysis

All data obtained were subjected to analysis of variance and significant means separated using SAS (1999).

RESULTS AND DISCUSSION

The result of growth variables of the broiler birds at the end of the eighth week are as presented in Table 3. Average feed intake, average weight gain and feed conversion ratio were not significantly (P>0.05) different among the various inclusion levels of fossil shell as growth promoter. This revealed that the diets had almost equal contribution to growth variables of the birds. However, numerically the average feed intake was declining as the inclusion level of fossil shell increases; with diets A and E having the highest and least feed intake respectively. Though not significant, this trend in the feed intake could be attributed to the dusty nature of the fossil shell as reported by Tewe (1991); which may cause off-feed situation by nasal irritation. The highest average body weight gain on diet A (0% FS) may be ascribed to the free intake of the diet. Still numerically, diet C had the least value for feed conversion ratio among the experimental diets, this tends to show that diet A without fossil shell (0% FS) could have the highest average feed intake and average weight gain but 3% fossil shell diet enhanced the best feed utilization among the diets. This 3% level of fossil shell inclusion tends to be higher than the 2% inclusion level recommended by the governments of the United States and Canada in livestock diets.

The result of the haematological indices of the birds fed the experimental diets is as presented in Table 4. The

Table 3. Growth variables of broiler birds fed with different levels of fossil shell flour

Parameter	A 0%FS	B 2%FS	C 3%FS	D 4%FS	E 5%FS	SEM
Average feed intake (kg/bird/week)	1.26	1.18	1.16	1.10	1.04	0.08
Average weight gain (kg/bird/week)	0.61	0.50	0.57	0.47	0.44	0.04
Feed conversion ratio	2.07	2.33	2.04	2.34	2.36	0.07

Values with different superscripts on the same row are significantly different (P< 0.05)
SEM = Standard error of mean, FS= Fossil shell

Table 4. Haematological variables of broiler birds with different levels of fossil shell flour

Parameter	A 0%FS	B 2%FS	C 3%FS	D 4%FS	E 5%FS	SEM
White blood cells	14.56^{ab}	15.44^{a}	11.39^{bc}	11.70^{bc}	10.09^{c}	0.59
Serum protein	5.67^{a}	4.96^{b}	6.04^{a}	6.42^{a}	6.29^{a}	0.12
Glucose	120.25^{b}	123.00^{b}	134.75^{b}	137.75^{ab}	152.75^{a}	0.25
Albumin	3.37	2.48	2.04	2.85	2.78	0.09
Globulin	3.29^{ab}	2.84^{b}	3.64^{a}	3.57^{ab}	3.51^{ab}	0.17
Red blood cells	1.89^{b}	2.09^{b}	3.66^{a}	4.34^{a}	4.30^{a}	0.17
Packed cell volume	27.88	26.88	28.38	27.13	27.70	0.50
Haemoglobin count	9.29	8.96	9.46	9.04	9.23	0.17

Means with different superscripts on the same row are significantly different (P< 0.05)
SEM = Standard error of mean, FS= Fossil shell

various inclusion levels of fossil shell only significantly (P< 0.05) affected the levels of white blood cells, total protein, glucose, globulin and red blood cells of the birds while albumin, packed cell volume and haemoglobin count were not affected significantly (P>0.05). Though values obtained for white blood cell under the various inclusion levels were within the normal range values reported for chickens (17-31) by Mitruka and Rawnsley, (1977) but the value on diet B (2% fossil shell) significantly (P<0.05) appeared highest among the experimental diets. This tends to present birds on diet B to be most immuned against infection. The glucose value increases as the level of fossil shell inclusion increases from 2% to 5%; with birds on diet E being significantly having the highest glucose value that is almost identical to diet D. However, birds on diets A, B, C and D had similar glucose values. Therefore, birds on diet E (5% fossil shell inclusion) could have more available metabolizable glucose as source of energy. It implies then that fossil shell inclusion enriches the energy source of broilers. The birds on diet B significantly had the least total protein value among the birds fed the diets, with birds on diets C, D and E having similar total protein value to birds on diet A (without fossil shell) that had the highest glucose value. Hence fossil shell inclusion promotes equal synthesis of body protein in all the diets except in birds on diet B that is least promoted.

The non significant outcome of albumin fraction of the total protein indicates that fossil shell inclusion equally promotes synthesis of albumin in birds fed all the experimental diets. In contrary, globulin was differently synthesized among the birds fed the different diets. The red blood cell count was significant (P<0.05) among the birds fed the different diets with diet A having the least count. This shows that fossil shell favours red blood production in broiler chickens. This could be evident of the fact that fossil shell four contains fourteen trace minerals, out of which iron could found, a major component of red blood cell. The fossil shell inclusion does not significantly affected packed cell volume and haemoglobin count of the birds fed the experimental diets but their values fall within the normal range for chickens (Mitruka and Rawnsley 1977; CCAC, 1993). This indicates the adequacy of iron in the fossil shell. This result however shows that the birds can still maintain their normal pulmonary function especially those dependent of haemoglobin content of the blood.

CONCLUSION

The least value of feed conversion ratio on diet C revealed that fossil shell could be optimally included into broiler diets up to 3% of the total maize in the diets. Haematological indices suggest that the health status of the birds were not adversely affected by the various inclusion levels of fossil shell in their diets. Hence fossil shell could still replace maize in broiler diets up to 5% level; however efforts towards reducing the dustiness of fossil shell could promotes more of its benefits. This study could be extended to layers to know its effect on egg production.

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